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ABSTRACT

Science and poetry are both ways of knowing about the world and they can be combined and integrated in classroom instruction. In the most productive educational theories, both science and writing are seen as methods of creating meaning. Science is treated as the process of examining individual pieces of data and observation to form generalizations; writing, in the process-oriented classroom, is recognized as a method of making meaning, the act of forming one's ideas and experiences into writing. Science and poetry involve: (1) making close and careful observations; (2) making connections; and (3) forming an empathic identification. It is wonder and awe that bind poetry and science together in their attempts to closely observe, to discover and create connections, and to offer their results for empathic identification. (Fifteen specific poetry writing activities are included.) (RS)

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POETRY AND SCIENCE IN THE CLASSROOM

by

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"When I heard the learn'd astronomer...
How soon unaccountable I became tired and sick,
Till rising and gliding out I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars."
--Walt Whitman
"When I Heard the Learn'd Astronomer"

The image of a poet fleeing from the numbers, lists, and charts of the scientist into a silent contemplation of nature is not an unfamiliar one. It is easy to put science and poetry in opposition to each other: one seems to depend on logic, the other on intuition; one deals with the objective aspects of life, the other with the subjective; one deals with proof, the other with a suspension of disbelief. Yet science and poetry are both ways of knowing about the world, as Whitman himself illustrates in other poems, and they can be combined and integrated in classroom instruction. This article will conclude by suggesting activities that combine and integrate the processes of poetry and science, but there are difficulties standing in the way of classroom application that must be understood.

First of all, the familiar dualism of science and poetry must be challenged. There is a popular misconception that science relates to the brain and poetry to the heart; since the conventional view holds the brain and heart to be often opposed, or uneasily allied with each other, the promise of conflict is present in a poetry-and-science learning experience. But science is not hard fact and poetry is not soft emotion. We have had discussions for several decades now about "the mind" which show how the brain and body are connected, how reason and intuition combine, how science can be informed with human intent and poetry illuminated with intelligence. The old dualisms do not hold, if they ever did, and we teachers can find ways to involve both modes of thinking, both ways of making meaning between ourselves and the world, in our classrooms. The argument, after all, is rarely between poets and scientists, who know from experience the connections between their disciplines. Thus Gary Snyder, a Pulitzer Prize winning poet, can speak of the poetic importance of knowing the names of the plants in one's environment and Roald Hoffman can discuss "molecular beauty" in an essay on chemistry.

There is a second misconception of a different nature which will also affect the teacher's use of either science or poetry in the classroom. Popular attitudes about both disciplines are very ambivalent and this makes them hard to teach, both for the same reason. On the one hand, science and poetry are highly regarded in our culture: being a "rocket scientist" is a current colloquialism for being intelligent, and the phrase "poetry in motion" to describe a dancer or athlete is high praise. On the other hand, the figures of poet and scientist are often figures of scorn

as well. The traditional absent-minded professor, unconnected to the realities of daily life is, after all, surely not a professor of finance or business education, but more likely a physicist or literary figure. The wide eyes and long hair of Albert Einstein and Allen Ginsberg have imprinted themselves as a stereotype on popular U.S. culture.

Thus, our cultural attitude is one of cognitive dissonance. Poetry is tremendously important to high culture but most of us can't write it or understand much of what is written; science is now a national priority but it is also abstract, complicated, and somewhat weird. The teacher, then, will need to be aware of both of these potential barriers to integrating science and poetry: the ambivalence with which society regards both endeavors, and the antagonistic positions into which they are often forced. Fortunately, good teaching is the same in both disciplines, as is bad teaching, and an examination of what such teaching constitutes can help us discover how to integrate the two modes of learning and experiencing the world.

THE TWO WAYS OF TEACHING: PRODUCT AND PROCESS

In the most productive educational theories, both science and writing are seen as methods of creating meaning. Science is treated as the process of examining individual pieces of data and observation to form generalizations; writing, in the process-oriented classroom, is recognized as a method of making meaning, the act of forming one's ideas and experiences into writing.

But both science and poetry can be presented in the opposite manner, as simply a given piece of knowledge to be absorbed or replicated. In such classrooms, science becomes the memorization of facts and generalizations already arrived at, poetry reading comes down quickly to "what does the poem mean?" and poetry writing involves fulfilling the mechanical requirements of a given form. In all these cases, students do not work as scientists or poets work, and they are deprived of the experience of making meaning in either discipline. The end results of studying science or poetry become "Chlorophyll makes grass green" and "The poet is saying that nature is beautiful." The end results of actual classroom activities can illustrate the same problem: the good student is one whose experiment results in the right answer or whose haiku contains the correct number of syllables.

On one occasion, my son brought home a junior high multiple-choice science test. Seeing that he had put the correct letter opposite "estuary," and realizing that I wasn't sure what an estuary was, I asked him, only to find out he couldn't tell me. So tightly and logically did his test repeat the structure of the study-guide, which repeated the structure of the textbook with its capitalized headings and bold-faced vocabulary, that he ended up knowing the "order" of the answers rather than the answers themselves. The red "A" in the upper corner of his test signified only the appearance of scientific knowledge.

That same year I was in a classroom where the students' only experience of poetry involved the cover of their social studies reports where they were to devise an acrostic based on the particular country. One of them was on India:

Interesting
New
Different
Intelligent
Awe-inspiring

The lack of thought in this poem was fairly representative of the other acrostics as well. They were, as acrostics, like the right letter in

a slot on an exam. The students had arrived at the product in ways which showed they had not been involved in the process of reaching some meaningful form.

Science and poetry, therefore, can both be badly taught in the same way. Fortunately, they can both be taught well in the same way: as a process of discovering and making meaning through the forms of the two modes of knowing.

THE PROCESS OF SCIENCE AND POETRY

If one is to combine the two modes of poetry and science in meaningful learning activities while stressing the importance of these modes as a process of making meaning, the similarities between the two processes may be an important aspect to discover. I offer here what I believe are important parallels, though the list is certainly incomplete, between the processes of science and poetry. After identifying these, we can look at poems that deal with science through these criteria and, in conclusion, suggest poem-writing activities that meet these same criteria.

1. OBSERVATION

Close and careful observation is important in both poetry and science although, again, some popular views of both forms of knowledge fail to take this fact fully enough into account. Poetry may be seen as simply "making up" something, delivering oneself of an emotional opinion; science may be seen as a matter of mixing a few chemicals or reading data-sheets and almost automatically coming up with a proof or disproof of a theory. But both poets and scientists believe, of necessity, in the value of close and careful and sometimes long observation. An error in science is not to "notice" something important; an equal error in poetry is not to "notice" the unique individual image that is new for the subject.

A study of coyote territoriality cannot be done by simply observing that they run around all over; a poetic description of spring is not arrived at by hauling in stereotypical images of birds singing in trees. Any writing activity, therefore, that stresses close, careful, and specific observation will help a student develop in both modes of knowing.

2. CONNECTION

An important aspect of both science and poetry is the making of connections. Without this element of connectiveness, both the scene of a poem and the problem under scientific study will become lifeless and nonproductive. Such connections range from the logic of cause and effect to the vivid comparison involved in a metaphor, and both science and poetry avail themselves of these connective devices as well as all those in between. Connections may be the direct association between two things, and this is seen in both scientific and poetic modes, or they may concern ever-widening circles and loops of association to provide an ecology for either poem or scientific study.

Discovering and creating activities in the classroom which require and allow the student to make connections between the parts of his/her writing, between particular specific observations, will aid in discovering and making both good poetry and good science.

3. EMPATHETIC IDENTIFICATION

Eisner has noted that "it is through aesthetic experience that we can participate vicariously in situations beyond our

practical possibilities" (Ways of Knowing, p. 28) and poetry certainly offers a way to "be" something one is not. An intuitive, empathetic identification with an object or a creature or an element of nature can lead to a greater understanding of one's subject. Einstein's empathetic imaging of himself traveling the speed of light to obtain "scientific knowledge" is well known. So, too, is Whitman's identification with the tremendous variety of human beings and occupations and places in his poetry in order to speak of and for the United States. Engineers in a synectics workshop imagine themselves to be the reluctant part of a machine in order to improve their design. Empathetic identification with one's subject leads to new meanings in both poetry and science.

One warning, however, is in order here, particularly with regard to poetry. After all, we writing teachers have had students writing "as if" they were their shoes, the pencil sharpener, or a bear for decades. But there is a difference between actually identifying with something other than ourselves and a thoughtless anthropomorphism. Too frequently in such exercises students do not become the thing but have the thing become themselves: pencil-sharpeners then complain about people poking pencils into them, shoes complain about people's smelly feet, and a bear wants only "to eat people up." The purpose of such activities as promoting empathetic identification is defeated by such casual anthropomorphizing.

The above three categories—observation, connection, and identification—are, of course, not a complete list of the similarities between the processes of science and the processes of poetry. But trying to apply them to both our poetry-reading and our poetry-writing activities will sharpen our senses, and our students' senses, of what can be discovered in such activities.

SCIENCE, POETRY, AND THE READING OF POEMS

Many books of children's poetry contain poems that "relate" to science and the natural world and can accompany a unit, or other science activities, in the classroom. In my experience, however, there are two different approaches taken by children's poets, and teachers may wish to consider their relative merits.

One of the main approaches of children's poetry is to utilize knowledge of the subject and put it "into" the form of a poem. Thus, a poem about fall can be composed of generalized or conventional observations and it is relatively easy to make one up: "Fall is coming to our town. The leaves are yellow, red, and brown." Indeed, it is this conventional tendency of much children's poetry which has led writers in the schools and teachers concerned about poetry to find more satisfying poetic experiences in contemporary poems written for adults but still available to younger understandings than in much of what passes as children's poetry.

Effective and interesting poems have been written in this approach, of course, and often they are clever and witty while offering an alternate method of presentation of their subject. Their limitation is, however, that they often break no new ground and lead to no personal discoveries.

Jack Prelutsky, certainly a popular and deserving children's poet, illustrates this approach in "Long Gone" which begins "Don't waste your time in looking for / The long-extinct tyrannosaur" and, after cleverly rhyming various "-saurus" words, ends with "They all lived here long before us." These are well-written, musical verses on the subject, but they only utilize the reader's knowledge rather than adding to it. In the same vein, Maxin

Kumin, an excellent adult poet, writes, in "Polliwogs": "Salamanders, toads and frogs / All begin as polliwogs." The neatly rhymed and metered poem cleverly sums up the eggs-to-tails-to-legs growth of such creatures.

In contrast to this approach of versifying already known data is the kind of children's poem which invites interaction by prompting or promoting empathetic identification of the natural world. Karla Kuskin begins a poem about a tree with "If you stood with your feet in the earth / Up to your ankles in grass / And your arms had leaves running over them...." The poem goes on to further present what it would feel like to be a tree, an example of true empathetic discovery. Aileen Fisher does the same when she asks us, in "Windy Tree," to "think of the muscles / a tall tree grows / in its leg, in its foot, in its widespread toes."

These are just a few examples, since there are many poems that do promote observation, the making of connections, and empathetic identification regarding their subject. But there are also many that do not, and it is important to recognize the differing types, purposes, and strengths of available poetry. Reading poetry connected with science is not simply a matter of finding a poem "about" dinosaurs when studying dinosaurs. If the poem is conventional or trivial, it will conventionalize and trivialize the child's experience of both poetry and science. If it promotes observation, connections in the world, and identification with the subject, the poem cannot help but push toward both good science and good poetry.

SCIENCE, POETRY, AND THE WRITING OF POEMS

Space prohibits the presentation of the following ideas in "scenario" form, complete with motivational introductions, guides during the process of writing, and extensions after the completion of the activity, but it is hoped that they will be seen as valid poetry (science) activities, capable of being fitted into the teacher's own practice of teaching and learning about poetry.

Poems of Observation

1. Observe an object (apple, spider, tree, etc.) and list all the qualities of a sensory nature (what can be seen, heard, felt, tasted, smelled). Then use these vivid sensory words in a poem to present that object as vividly as possible to the senses.

2. Observe a scene and write a few lines (or a poem) about that scene. Now write another poem on the same scene without using any of the things noticed in the first poem. A poem that mentioned the trees, cars, houses on a street, for example, would, in its second version, focus on things not observed as important before.

3. Observe something and write a few lines (or a poem). Observe it over a period of time, writing about it each time, noticing the changes that occur about, or around, it.

4. Develop a list of vivid verbs that describe the various ways animal$ move. A squirrel _____, a cat _____. Do the same thing, making the verbs alliterative with the animal: a snake s_____, a cat c_____. Write a poem about several animals moving; writing a poem about one animal and all its motions.

5. Pick a color and observe everything in a particular scene that is that color. Write a poem on that color and those things.

6. Write a poem about something in your

environment that is small (make up rules: less than an inch long, for example). Observe that small thing in all its detail and try to get as much detail as possible into the poem.

Poems of Connection

1. Connections of time: Pick a suitable natural subject and begin your poem with your subject's beginning, starting the first line with "Once...." Everything from a tree, river, or mountain to the land and the earth itself could be suitable. Start the next stanza with "And now..." or "But now..." and write several lines to describe the present existence of your subject. Perhaps another stanza could be added to describe the probable future of your subject.

2. Connections of cycles: Pick a metamorphosizing or cyclical subject (the life cycle of a flower, a tree, a butterfly, a frog, the water cycle) and present that cycle with as much vivid detail as possible. Try to write several detailed lines or stanzas for each stage of the process.

3. Connections of metaphor: Almost any type of metaphor-writing in the classroom will develop "connecting" abilities. These activities can range from personal metaphors ("I am like a tree when I...," "I feel like a snowstorm when I...," or "When I'm mad I feel like a...") to the more obviously science-oriented ("A stream of electrons is like _____" or "Magnetism is like _____").

4. Connections of scale: Write a poem that takes place during some interesting weather (raining, wind blowing, snowing, etc.). Start by showing close-up details of you in that situation, then something around you, then something more distant, continuing to the farthest or largest scale possible. Can you show what the rain or snow or wind is doing from the most immediate location to the most distant? (Or reverse the order, starting in the sky with the rain and ending with the scene at your feet, writing as much in between as possible.)

5. Pick an animal and write about "its day," detailing what it sees and does and what it comes in contact with throughout its day.

Poems of Empathetic Identification

1. "I am _____" poems. As mentioned above, this poetic starter is common although the teacher may need to model and use questions to keep the activity from becoming totally anthropomorphic. For example, to keep "I am the floor" from becoming a silly exercise in the complaints of a floor about all those shoes, ask the student to actually try to feel what it feels to be a floor: Do you feel strong or weak? What makes you feel that way? What's the best thing about being a floor? If you're a floor, what are your hands doing? Your legs?

2. Empathetic identification can be gained through "I am (an animal)" poems, but the above warnings still hold. Emphasize the actual nature of the animal—what it actually feels like to fly or to swim. Emphasize different times during that animal's existence—going to sleep, waking up, hunting, playing, and the like—in order to get more specific details.

3. Identify with processes not naturally observable, after a lesson about those processes (electricity, magnetism, etc.) and write a poem as if you are part of this process.

4. Identify your world: Be an ant and describe what your world looks like from

your point of view, being very observant and detailed in your description. Be a cell and describe your world. Be standing where you can view the whole solar system and describe it as if you were seeing it all before you.

WONDER AND AWE

Originally, I wanted to include this category, common to both poetry and science, as a similarity between their methods, going on to identify approaches to poetry which emphasized wonder and awe. This proved to be too difficult a criteria to discuss in totally practical terms, but it serves as a good conclusion for this discussion.

Wonder and awe do not sound like scientific principles but they are often the motivation for scientific endeavor as well as the result. Indeed, there are scientific "facts" which promote almost the same emotional involvement and thoughtful reflection that poems do. My current favorite is that the human race is not much more than a trillion seconds old. The combination of such an extensive reach of time with our sense of what a "second" is, in my opinion, excites a sense of wonder that opens the individual to all the elements of time, and life, at once.

It is wonder and awe that bind poetry and science together in their attempts to closely observe, to discover and create connections, and to offer their results for empathetic identification. It is what binds the last part of Whitman's poem, quoted at the beginning of this piece, to an integration of poetry and science. We must remember that the poet did attend the astronomy lecture in the first place; and we must remember that astronomers are capable of silent contemplation in the "mystical moist night-air"; indeed, their knowledge makes the night sky even more wondrous than a handful of popular constellations or an unobserved backdrop to romance. We need astronomers in the open air and we need poets at the lectures; out of this integrated knowledge comes the wonder and awe that is both a motivation for meaning and the satisfying result.

In some classroom poems, this wonder and awe will come through, on purpose or accidentally; in other cases, it will not. It is impossible to demand, of course. But in closely observing, connecting, and internalizing our experience, we are laying the groundwork for those moments of creating meaning, of finding the intersection of the individual and of the cosmos which is the joint enterprise of science, of poetry, and—we must not forget—of education.

Poet Robert King is professor of English and Elementary Education at the University of North Dakota. He is also editor of Teaching and Learning, a publication of the Center for Teaching and Learning.

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